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I. INTRODUCTION

Summarized in this report is the work carried out during the past six months on the study of the relation between the electromagnetic scattering properties and the surface characteristics of the moon and planets. The major effort of this period has been directed toward completing the reduction and analysis of the previously acquired CW radar moon data. The results of these efforts are outlined in the following section of the report.

II. LUNAR RADAR STUDIES

By means of The Ohio State University "Saucer Field" facility, a Doppler spectrum experiment was completed in 1965. The transmitted signal (10 kW, 2270 MHz CW) was provided by the Ohio University Radar Hill. Vertically polarized signals were transmitted and both vertical and horizontal received in order to study the depolarizing effects of the moon's surface. The received signals were downconverted to an audio frequency of about 150 Hz and recorded on magnetic tape.

The data were later digitized, initially at Wright-Patterson Air Force Base and later by The Ohio State University Computer Center. Data analysis was performed on the IBM 7094 and IBM 1620 computers at the Computer Center. The results will appear in a forthcoming report.

Among the results obtained are direct- and cross-polarized power spectra, examples of which appear in Fig. 1a, b. From these spectra were obtained the corresponding back scattering functions (Fig. 2a, b), which play an important role in describing the radar properties of a surface. Included also in Fig. 2a are the backscattering functions[1] obtained by Pettengill (68 cm), Hughes (10cm) and Evans (3.6 cm). The curves of Pettengill, Hughes and Evans were derived from pulse-radar experiments, which have inherently low resolution at the lower angles of incidence. The Ohio State University curve, on the other hand, from CW-radar experiments, has its greatest resolution at small incidence angles.

In the above-mentioned report will be given estimates of: (1) the total radar cross section for both direct- and cross-polarized cases; (2) the mean dielectric constant; and (3) the mean slope for the moon's surface.

III. PROPOSED PROGRAM FOR October 1966 - April 1967

It is proposed that, during the next six months, a feasibility study be made of a two-frequency radar system. Such a system should prove useful in the study of remote surfaces such as those of the moon and of the planets. A two-frequency system could provide, besides the information obtainable by standard, single-frequency radar, an estimate of the RMS height of the surface roughness, an invaluable bit of information in regards to the selection of suitable spacecraft landing spots.

Considerable effort has already been expended in a theoretical study of the determination of the RMS height of surface roughness by a two-frequency radar, as reported in Reference 2. Any further study would be based on these results. It would consider both ground- and spacecraft-based radar systems, and would include consideration both of the practicality of instrumentation and of the amount of information obtainable. Some of the difficulties encountered in Reference 2 could be avoided under conditions such as those encountered by spacecraft in orbit about the moon or a planet.

IV. REFERENCES

1. Evans, J. V., "Radar Observations of the Moon," Radio Science, Journal of Research, National Bureau of Standards, Vol. 69D, No. 12, December 1965.

2. Barrick, D. E., "Determination of RMS Height of a Rough Surface Using Radar Waves," Report 1388-19, 31 August 1965, Antenna Laboratory, The Ohio State University Research Foundation; prepared under Grant NsG-213-61, National Aeronautics and Space Administration, Washington, D. C.

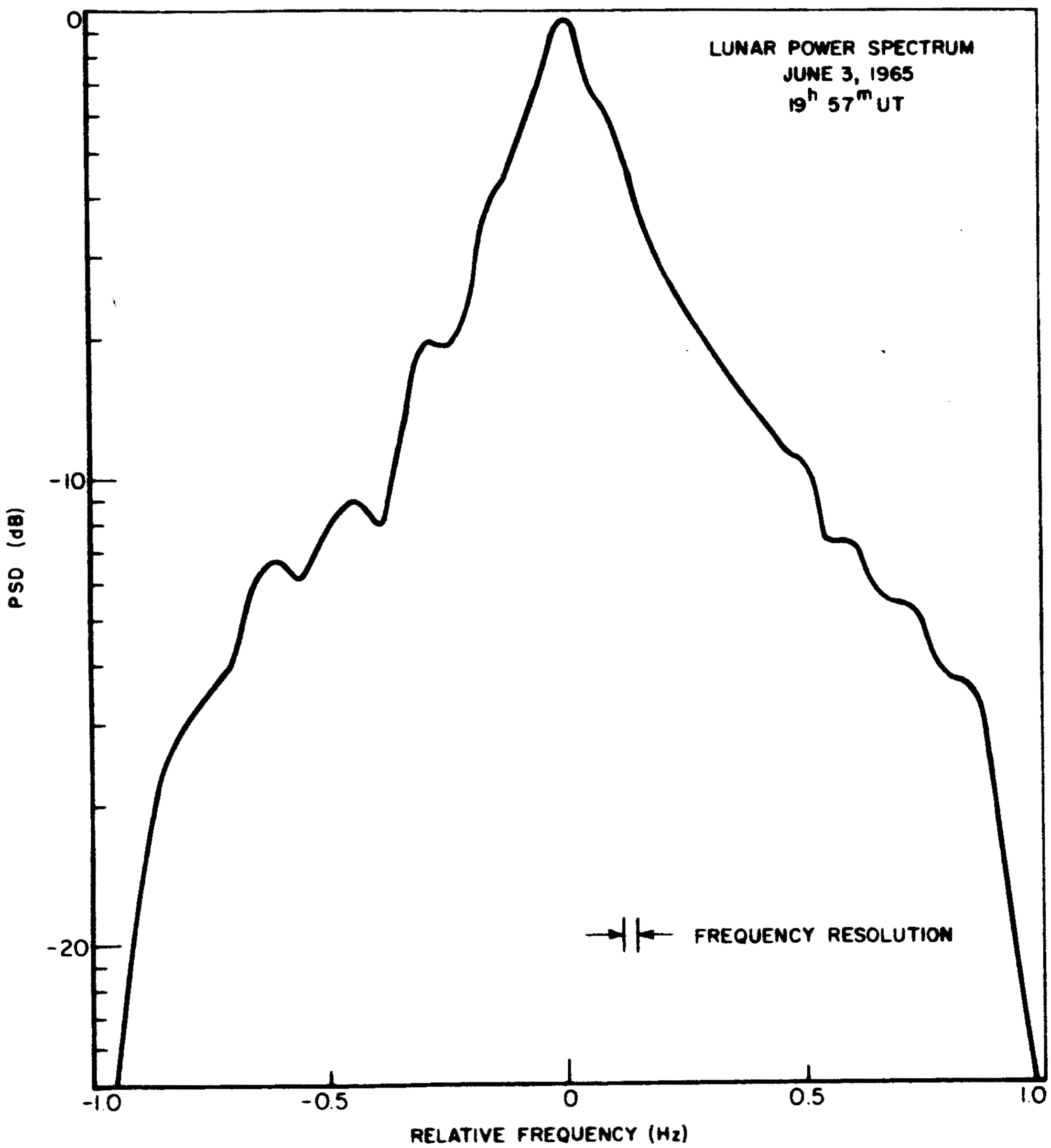

Fig. 1a. Power spectral density of direct-polarized radar return (VP transmitted, VP received).

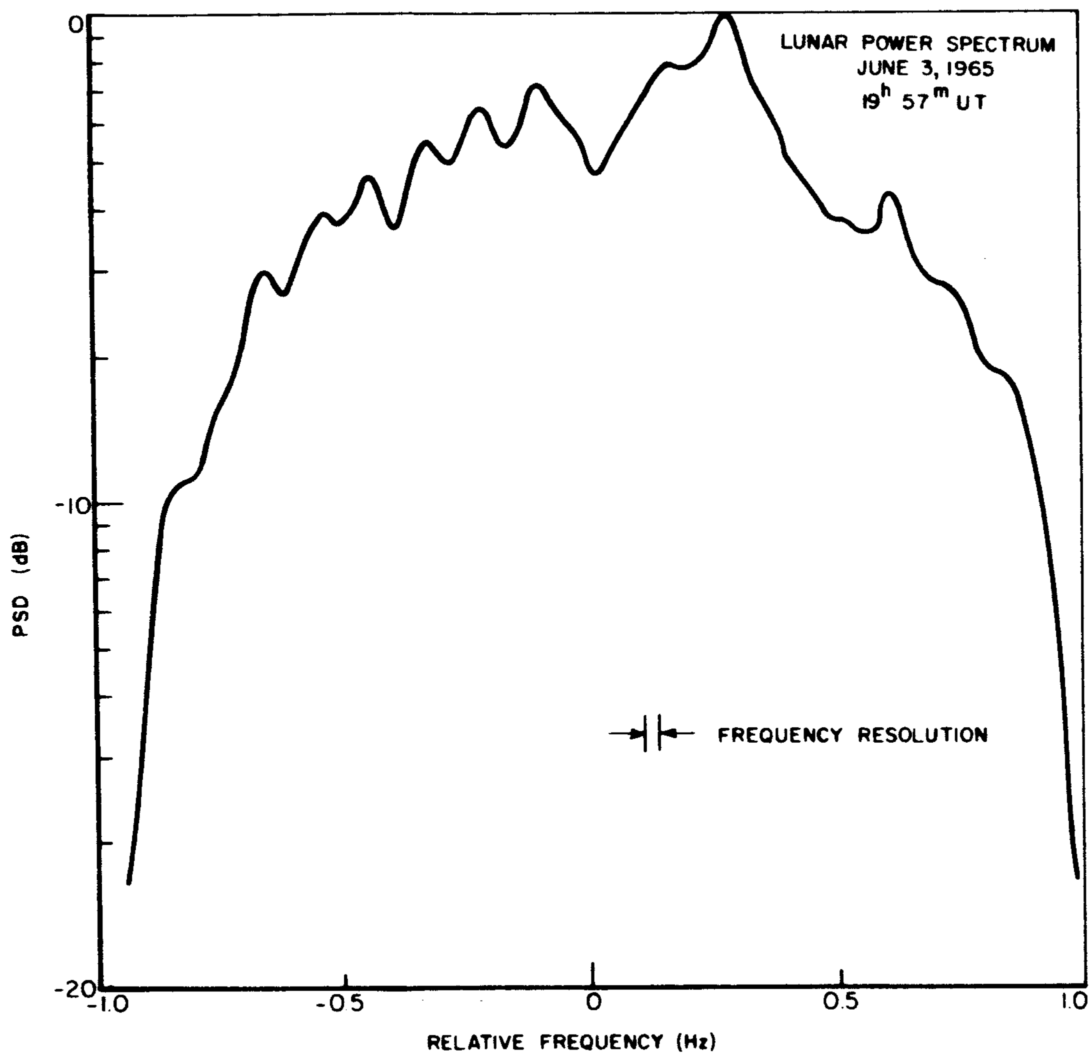

Fig. 1b. Power spectral density of cross-polarized radar return (VP transmitted, HP received).

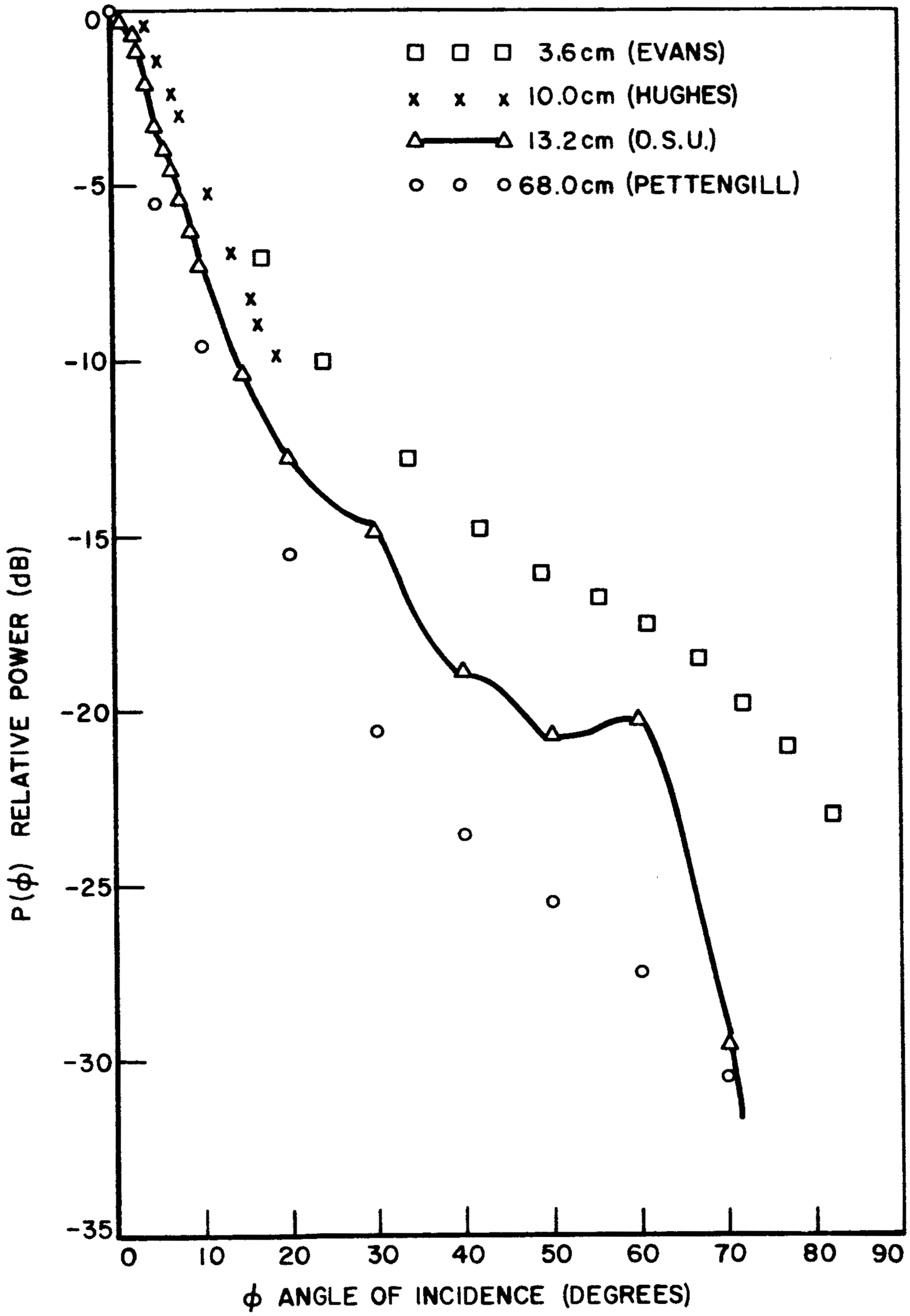

Fig. 2a. Backscattering function, VP transmitted, VP received.

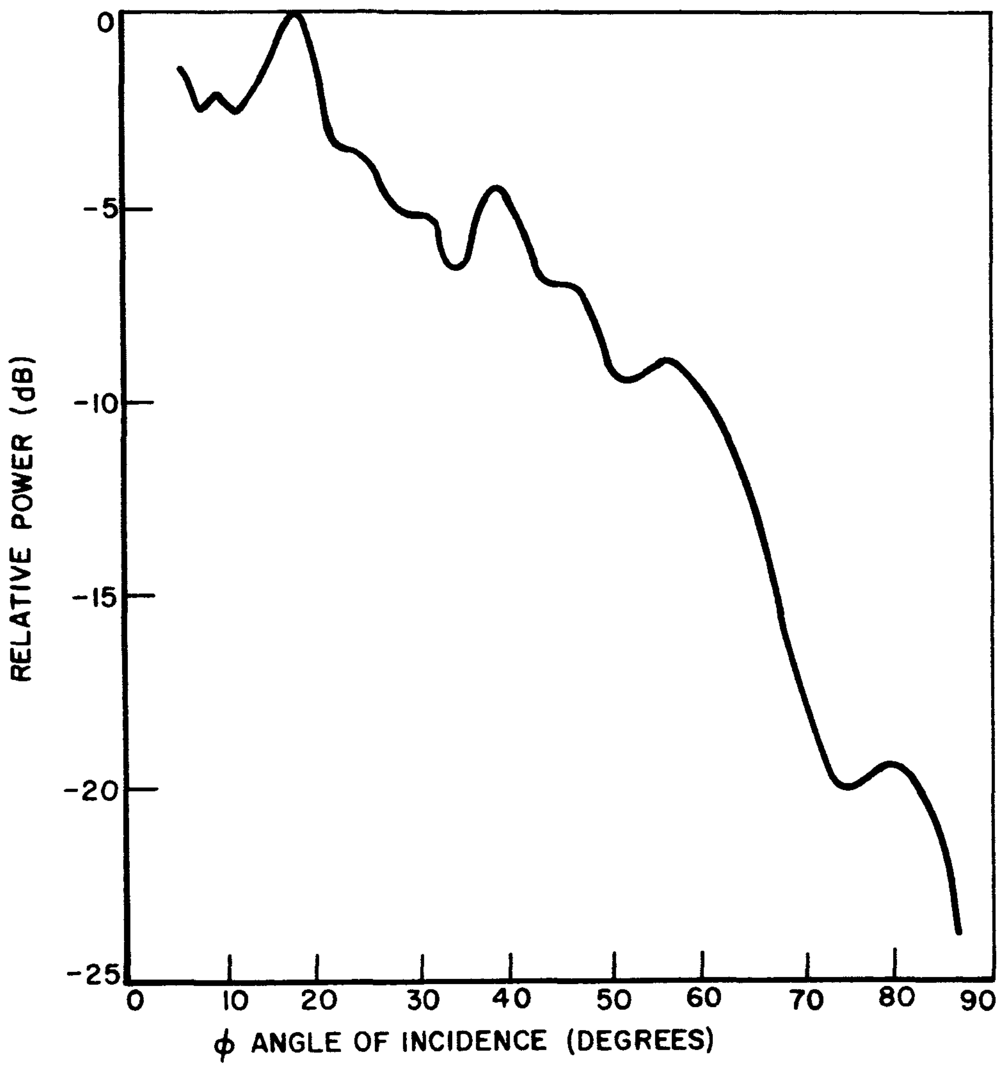

Fig. 2b. Backscattering function, VP transmitted, HP received.